ABSTRACT

The present invention relates to a method of intelligent 2D and 3D object and scene modeling, transformation and manipulation and more particularly this invention relates to the field of computer modeling, virtual reality, animation and 3D Web streaming. The method uses attributed hypergraph representations (AHR) for modeling, transforming and manipulating objects. From one or more 2D views of a 3D object or scene, range information is first computed and then a triangular mesh model is constructed. The data structure is designed to handle the transformations on the representation corresponding to movements and deformations of the object. In an attributed hypergraph, the attributes associated with the hyperedges and the vertices facilitates modeling of various shapes with geometrical, physical or behavior features. As a hierarchical and generic representation, AHR enables pattern matching, recognition, synthesis and manipulation to be carried out at different resolution levels on different subsets depending on the context. Symbolic computation on knowledge represented in the format of attributed hypergraphs becomes straightforward. Given the features of a 3D object or scene, the procedure of constructing the AHR corresponds to the concept of *functor* in category theory, which maps one category to another one. The transformations of AHR are in the form of a set of operations defined on attributed hypergraphs, which stand for the motions and deformations of the object. This representation is applied to various modeling and manipulation tasks on 3D objects. The process of motion analysis of a 3D object is the task of extracting a sequence of AH operators from the AHR of the object. A 3D scene can be modeled by AHR and then altered/augmented with other 3D models, by which an augmented reality can be built. Given the AHR's of two different 3D shapes, 3D morphing may be accomplished by matching the two AHR's and then mapping the difference to a sequence of AH operators. Model based animation of an object can be accomplished by applying a set of AH operators to its AHR. The AHR method forms a data compression system for efficient web streaming over the Internet.